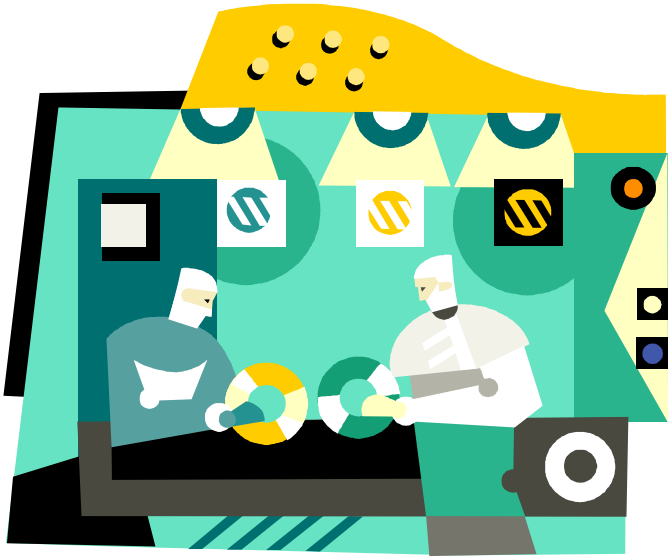
Manufacturing in Missouri
Diversification and Specialization



INDUSTRY ANALYSIS

IND-0402-1
April 2002

MISSOURI DEPARTMENT OF ECONOMIC DEVELOPMENT

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Key Findings

- The manufacturing sector still continues to be an important part of local and regional economies in the United States, especially in rural areas. Given the nature of the global economy, policy-makers need to identify areas of economic comparative advantage that they can build upon; and areas of economic vulnerability that need to be strengthened.

- In 2000, counties that had a fully diversified manufacturing base include Lawrence, Taney, St. Louis City, Buchanan, Greene, Jasper and St. Clair, Jackson, St. Louis County and Pettis. However, several counties were fully dependent on one type of manufacturing. These counties are located in the northern portion of Missouri and include Worth, Putnam, Sullivan, Gentry, and Monroe counties. Overall, by 2000 Missouri had a significantly diversified manufacturing base.

- Between 1990 and 2000, the number of counties that have above average specialization in *top-of-cycle* manufacturing has increased from forty-one in 1990, to forty-six in 1995, and to forty-seven in 2000. In 2000, specialization in top-cycle manufacturing was spread over most economic regions of the state, with a high concentration in 7 major areas.

- Between 1990 and 2000, the number of counties that had above average specialization in *bottom-of-cycle* manufacturing decreased from seventy in 1990 to sixty-eight in 2000. In 2000, bottom-cycle manufacturing was concentrated in the east central, southeast and southwest regions of the state.

- Between 1990 and 2000, the number of counties that are highly specialized in *resource-based* manufacturing declined from fifty-seven in 1990, to fifty-three in 1995 and fifty in 2000. This type of manufacturing has been concentrated in three main areas of the state. The south-central and southeast areas are involved mainly in the production of lumber and wood products, counties in the southwest corner of the state - involved in food processing, and finally, the central and north central regions of the state are primarily involved in agricultural and food processing.

- Between 1990 and 2000, the number of counties that are highly specialized in *high-technology* manufacturing increased from five in 1990 to eleven in 2000 In general, the northern, west central, south central and southeastern portions of Missouri have low concentrations of high-tech specialization, relative to the state as a whole.

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Analysis and reporting by
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I. Overview

The decentralization of the manufacturing sector following World War II created an abundance of jobs across the United States, becoming one of the main economic sectors in the country. However, since the mid-1980s manufacturing has been declining in importance as firms begin to automate production and move operations abroad. Despite these trends, the manufacturing sector still constitutes an important part of local and regional economies in the United States, especially in rural areas. Therefore, it is imperative that policy-makers understand the strengths and weaknesses of their manufacturing base. Given the nature of the global economy, policy-makers need to identify areas of economic comparative advantage that they can build upon; and areas of economic vulnerability that they need to strengthen.

It is important to understand that manufacturing is a diverse industry in terms of both the products it produces and the labor skills it requires - it cannot be conceptualized as a homogenous sector. Different types of manufacturing produce different types of positive and negative externalities. For example, manufacturing firms that require a high degree of skilled technical labor may produce a more educated workforce, higher wages, and globally competitive jobs that are secure. In contrast, firms that require little or no skilled labor may produce a poorly educated workforce, lower wages, and jobs that are prone to be moved to low wage nations abroad. Therefore, it is important that policy-makers understand the types of manufacturing that exist in their area in order to assess potential economic and external effects.

Using established typologies from the United States Department of Agriculture and the United States Department of Labor, manufacturing industries were classified into four groups based on two-digit and three-digit Standard Industry Classifications (SICs): top-of-cycle manufacturing, bottom-of-cycle manufacturing, resource-based manufacturing and high-technology manufacturing. These groupings reflect the types of product cycles characterizing each sector. Each aggregate sector is defined below. Refer to the appendix for a complete definition, including SIC codes.

Top-of-cycle manufacturing industries are those that typically require highly skilled technical labor. This includes the manufacturing of the following: printing and publishing products; chemicals and allied products; electrical machinery; machinery except electrical; transportation equipment except motor vehicles; and instruments and related products.

Bottom-of-cycle manufacturing industries are those that require assembly and materials handler labor for standardized production. This includes the manufacturing of the following: textile mill products; apparel and other textile products; furniture and fixtures; rubber and plastic products; leather and related products; stone, clay and glass products; primary metal products; fabricated metal products; motor vehicles and related equipment; and various other manufacturing industries.

Resource-based manufacturing industries are those that typically require access to natural resources or agricultural products. This includes the manufacturing of the following: food and kindred products; tobacco products; lumber and wood products; paper and allied products; and petroleum and coal products.

High-technology manufacturing industries are those that require an above average number of engineers, engineering technicians, computer scientists, mathematicians, and life scientists (including chemists and geologists). This includes the manufacturing of the following: industrial organic, inorganic, and agricultural chemicals; plastic and synthetic materials; drugs; soaps and detergents; paints and allied products; petroleum refining; engines and turbines; construction, metalworking, and industrial machinery; computer, audio, visual, and office equipment; electrical distribution equipment; communications equipment; electronic components; aircraft and parts; railroad equipment; guided missiles and space vehicles; tanks and components; search and navigation equipment; measuring and controlling devices; medical instruments and supplies; and photographic equipment.

II. Manufacturing Diversification Indices

The Manufacturing Diversification Index (MDI) is a simple calculation that measures the distribution of various industries within a particular area - measured by the proportionate distribution of the labor force. MDI is used to examine how well distributed manufacturing employment is between top-of-cycle, bottom-of-cycle, resource-based and high technology manufacturing. The importance of a diversified manufacturing sector is clear. Many areas within Missouri and the United States have experienced the deleterious effects of being too dependent on a single type of manufacturing. For example, areas heavily dependent on low-skill manual production in the 1980s experienced severe economic hardships when firms eliminated jobs due to automation and relocation to low wage areas abroad.

The MDI ranges from 0.0 to 1.0, and measures the distribution of manufacturing employment across the four categories. MDIs of 0.0 indicate that the manufacturing sector is completely diversified - there is an equal percentage of manufacturing employees in all four categories. MDIs of 1.0 indicate that the manufacturing sector is fully dependent on one type of manufacturing - almost all manufacturing employees are in one category. In general, lower MDI scores indicate a more diverse manufacturing sector.

$$MDI_{sector} = \sum_{i=1}^{n} \left(\frac{n}{n-1} \left(\left(\frac{SECTOR\_MFGR\_EMPL_{county}}{TOTAL\_MFGR\_EMPL_{county}} \right) - \frac{1}{n} \right)^2 \right)$$

The results show that Missouri has a significantly diversified manufacturing base. Between 1990 and 1995, the MDI score for the state of Missouri remained constant at 0.03, and increased to 0.07 in 2000. This indicates that Missouri's manufacturing economy is relatively robust, and would generally be able to withstand macroeconomic fluctuations. In order to compare the degree of diversification to the state levels, standardized z-scores were calculated for each county. The scores ranged from 0 to 4, and were categorized as follows:

0 - fully diversified
1 - significantly diversified
2 -moderately diversified
3 - significantly dependent
4 - fully dependent.

Diversification in 1990

In 1990, fourteen counties (12% of Missouri counties) were considered to have a fully diversified manufacturing base (MDI between 0.05 and 0.14). These are mainly concentrated around the metro areas and include St. Louis City, Newton, Jasper, Greene, and Jackson. In contrast, eight counties (7%) were fully dependent on one type of manufacturing. These include Monroe, Worth, Caldwell, Atchison, and Sullivan counties, located in the northern portion of Missouri. The fully dependent counties are all specialized in bottom of cycle manufacturing except Sullivan, which specialized in resource based manufacturing. All counties had diversification indices below the state score of 0.03 in 1990. Refer to Table 2.1.

Sixty-five counties had a diversification index between 0.11 and 0.33 and are considered significantly diversified. This accounts for 57% of Missouri counties. Nineteen counties (17%) were moderately diversified and nine counties (8%) were significantly dependent.

Eight counties (7%) were fully dependent on one type of manufacturing (diversification indices between 0.83 and 0.94). The type of manufacturing that the dependent counties specialize in are characterized by relatively low wages. The average annual wages for the fully dependent counties ranged from $8,965 in Worth County, to $22,967 for Monroe County. Refer to Table 2.2.

Map 2.1
County Diversification Indices, 1990

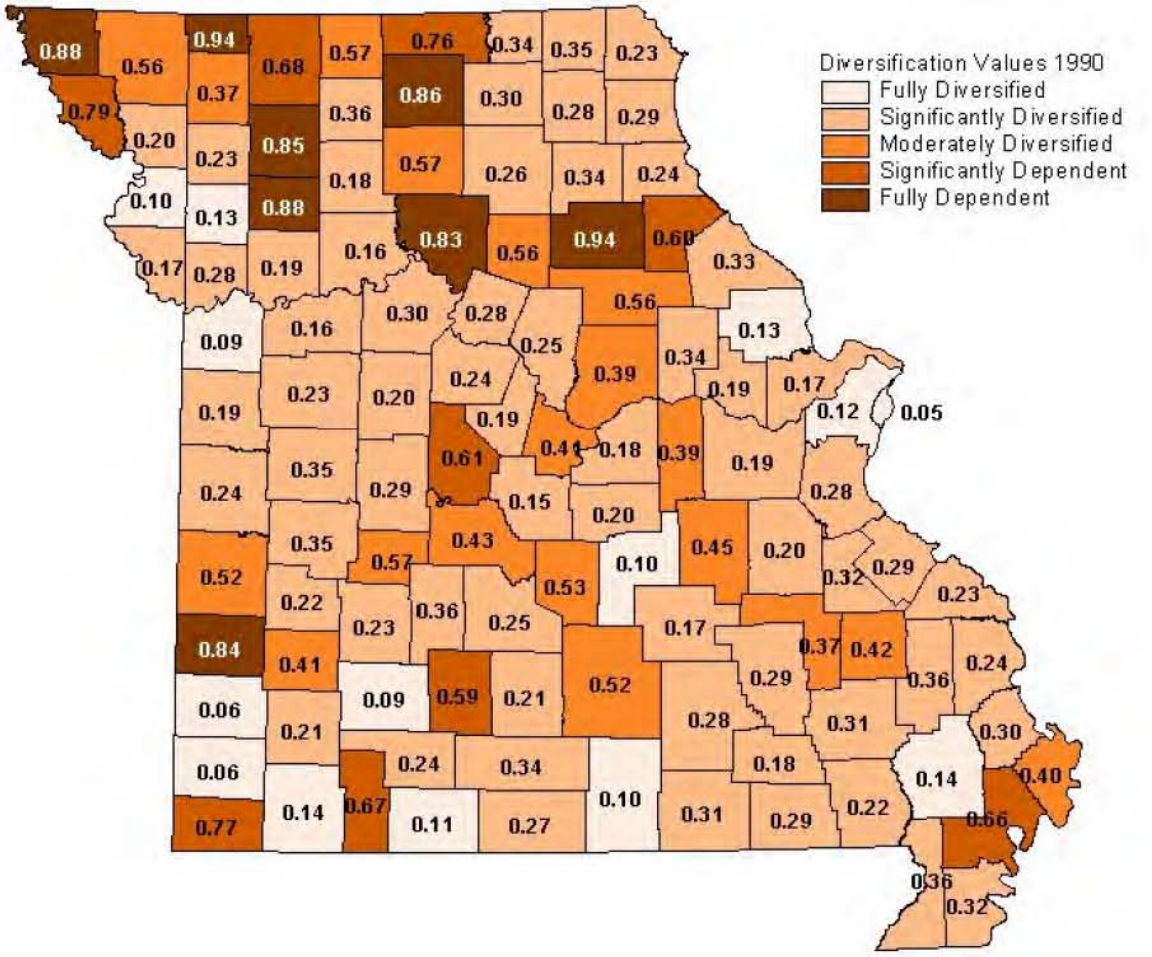

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Table 2.1
Missouri Counties with fully Diversified Manufacturing Sectors, 1990
Manufacturing Aggregate Sector Diversification Indices and Employment

COUNTY	AGGREGATE SECTOR EMPLOYMENT				DIVERSIFICATION INDEX
	Top Cycle Manufacturing	Bottom Cycle Manufacturing	Resource Manufacturing	High Tech Manufacturing	
MISSOURI	**151,359**	**133,345**	**75,583**	**73,743**	**0.03**
St. Louis City	15,797	13,265	14,657	4,390	0.05
Newton	1,444	1,773	1,667	375	0.06
Jasper	4,491	3,283	3,089	989	0.06
Greene	7,741	3,107	6,498	1,743	0.09
Jackson	19,638	18,931	6,133	5,966	0.09
Buchanan	2,577	2,590	3,878	323	0.10
Phelps	321	379	135	74	0.10
Howell	1,470	1,061	939	99	0.10
Taney	99	326	116	116	0.11
St. Louis County	37,505	17,745	8,384	52,670	0.12
Clinton	53	34	56	0	0.13
Lincoln	213	256	363	0	0.13
Stoddard	1,264	1,408	769	0	0.14
Barry	1,262	2,610	2,204	36	0.14

Source: MERIC, MO Department of Economic Development

Table 2.2
Missouri Counties with fully Dependent Manufacturing Sectors, 1990
Manufacturing Aggregate Sector Diversification Indices and Employment

COUNTY	AGGREGATE SECTOR EMPLOYMENT				DIVERSIFICATION INDEX
	Top Cycle Manufacturing	Bottom Cycle Manufacturing	Resource Manufacturing	High Tech Manufacturing	
Monroe	20	869	0	0	0.94
Worth	0	115	3	0	0.94
Caldwell	12	302	2	0	0.88
Atchison	16	0	320	0	0.88
Sullivan	23	3	748	18	0.86
Daviess	19	361	5	0	0.85
Barton	52	1,473	27	19	0.84
Chariton	22	461	11	0	0.83

Source: MERIC, MO Department of Economic Development

Diversification in 1995

In 1995, sixteen counties (14% of Missouri counties) were considered to have a fully diversified manufacturing base (MDI between 0.04 and 0.16). These are mainly concentrated around the metro areas and include St. Louis City, Taney, Phelps, Pike and Jasper counties. Seven counties (6%) were fully dependent on one type of manufacturing. These are Putnam, Worth, Monroe, Sullivan, Caldwell, Gentry, and Barton counties, most of them located in the northern portion of Missouri. Putnam and Gentry specialized in top of cycle manufacturing, and Sullivan specialized in resource-based manufacturing. All other counties were specialized in bottom of cycle manufacturing.

Only St. Louis City had a diversification index above the state score of 0.05 in 1990. Refer to Table 2.3.

Sixty-six counties had a diversification index between 0.16 and 0.36 and are considered significantly diversified. This accounts for 57% of Missouri counties. Eighteen counties (16%) were moderately diversified and eight counties (7%) were significantly dependent.

Seven counties (6%) were fully dependent on one type of manufacturing (diversification indices between 0.81 and 1.0). The manufacturing sector in Monroe is bottom of cycle, and is dominated by primary metals manufacture. Caldwell and Barton counties also specialize in bottom cycle industries predominantly leather and leather products, and furniture and fixtures respectively. Sullivan specializes in resource-based manufacturing, the main industry being food and kindred products manufacture. Putnam and Gentry specialize in top of cycle manufacturing. Top cycle manufacturing in the two counties is mainly in publishing and printing, and industrial and commercial machinery and equipment industries respectively. Refer to Table 2.4.

Bottom of cycle and resource-based manufacturing are characterized by relatively low annual wages ranging from $1 1,199 to $26,586. Although Putnam and Gentry specialize in top of cycle manufacturing which typically requires highly skilled technical labor and consequently higher wages, the average annual wages are also relatively low, $12,953 and $22,136 respectively.

Map 2.2
County Diversification Indices, 1995

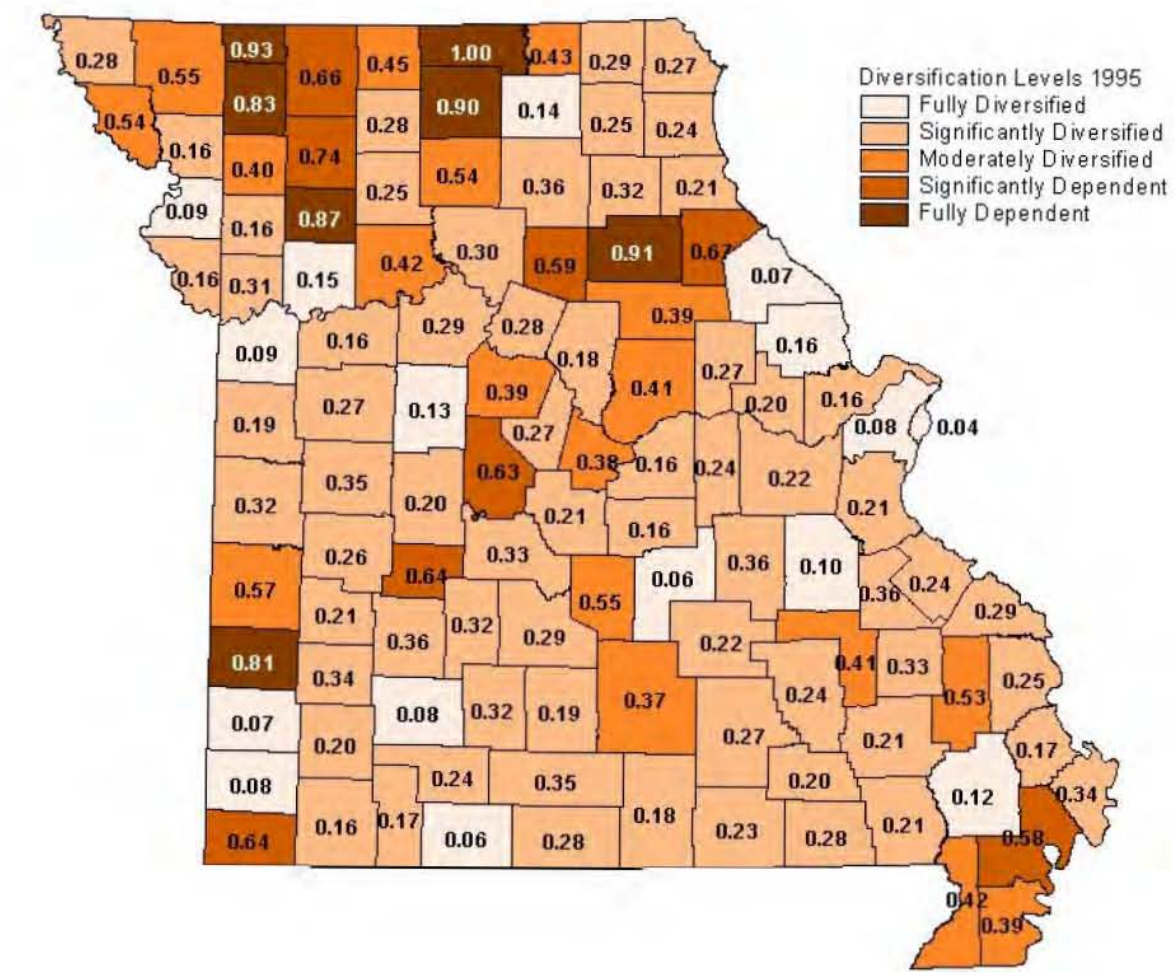

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Table 2.3
Missouri Counties with fully Diversified Manufacturing Sectors, 1995
Manufacturing Aggregate Sector Diversification Indices and Employment

COUNTY	AGGREGATE SECTOR EMPLOYMENT				DIVERSIFICATION INDEX
	Top Cycle Manufacturing	Bottom Cycle Manufacturing	Resource Manufacturing	High Tech Manufacturing	
St. Louis City	13,503	10,950	13,510	4,354	0.04
MISSOURI	**157,059**	**129,612**	**78,202**	**52,704**	**0.05**
Taney	200	340	81	236	0.06
Phelps	225	374	159	121	0.06
Pike	191	322	70	205	0.07
Jasper	4,228	3,993	3,581	677	0.07
St. Louis County	38,040	16,670	9,071	33,338	0.08
Greene	6,800	3,478	6,779	1,442	0.08
Newton	1,810	1,955	1,533	206	0.08
Jackson	19,272	15,120	6,250	4,988	0.09
Buchanan	2,161	2,441	3,244	313	0.09
Washington	62	102	110	12	0.10
Stoddard	1,271	1,115	859	0	0.12
Pettis	1,829	1,939	1,074	11	0.13
Adair	454	772	478	0	0.14
Ray	62	131	129	0	0.15
Lincoln	342	263	147	0	0.16

Source: MERIC, MO Department of Economic Development

Table 2.4
Missouri Counties with Fully Dependent Manufacturing Sectors, 1995
Manufacturing Aggregate Sector Diversification Indices and Employment

COUNTY	AGGREGATE SECTOR EMPLOYMENT				DIVERSIFICATION INDEX
	Top Cycle Manufacturing	Bottom Cycle Manufacturing	Resource Manufacturing	High Tech Manufacturing	
Putnam	100	0	0	0	1.00
Worth	0	111	3	0	0.93
Monroe	29	916	5	0	0.91
Sullivan	23	29	1,248	0	0.90
Caldwell	11	274	4	0	0.87
Gentry	292	8	13	0	0.83
Barton	90	2,016	45	25	0.81

Source: MERIC, MO Department of Economic Development

Diversification in 2000

In 2000, thirty counties (26% of Missouri counties) were considered to have a fully diversified manufacturing base (MDI between 0.02 and 0.17). This indicates a marked increase in diversification of the manufacturing base in Missouri counties from 14% in 1995. These are mainly concentrated in the metropolitan areas although there are a number of fully diversified counties located outside the metro areas. All economic regions have at least one fully diversified county. The most diversified counties include Lawrence, Taney, St. Louis City, Buchanan, Greene, Jasper and St. Clair counties. Five counties (4%) were fully dependent on one type of manufacturing. Overall, Missouri had a significantly diversified manufacturing base in 2000.

Lawrence, Taney and St. Louis City had diversification indices above the state score of 0.07 in 2000, which also indicates an increase in the diversification of manufacturing in these counties in relation to the state average. Refer to Table 2.5.

Fifty counties had a diversification index between 0.17 and 0.36 and are considered significantly diversified. They account for 44% of Missouri counties. Twenty-four counties (21%) were moderately diversified and six counties (5%) were significantly dependent.

Five counties (4%) were fully dependent on one type of manufacturing (diversification indices between 0.91 and 1.0). The five counties that were fully dependent were Worth, Putnam, Sullivan, Gentry, and Monroe counties, all located in the northern economic regions of Missouri. Manufacturing in Monroe is bottom of cycle, dominated by primary metals manufacture industries. Much of the manufacturing in Sullivan is resource-based, mainly in the food and kindred products industry. Putnam and Gentry specialize in top of cycle manufacturing which generally requires highly skilled technical labor and consequently be expected to have high wages. In this case however, Putnam and Gentry both have relatively lower wages. Top cycle manufacturing in the two counties is predominantly publishing and printing and industrial and commercial machinery and equipment respectively. Refer to Table 2.6.

Over the years, the manufacturing sectors in these counties have noted an increase in the average annual wages although most are still characterized by relatively low wages, between $15,474 in Putnam County and $28,898 in Monroe County. Although most Missouri counties have shown improvements in their diversification of manufacturing industries, the northern areas of the state are still economically dependent and vulnerable, and need to be strengthened.

Map 2.3
County Diversification Indices, 2000

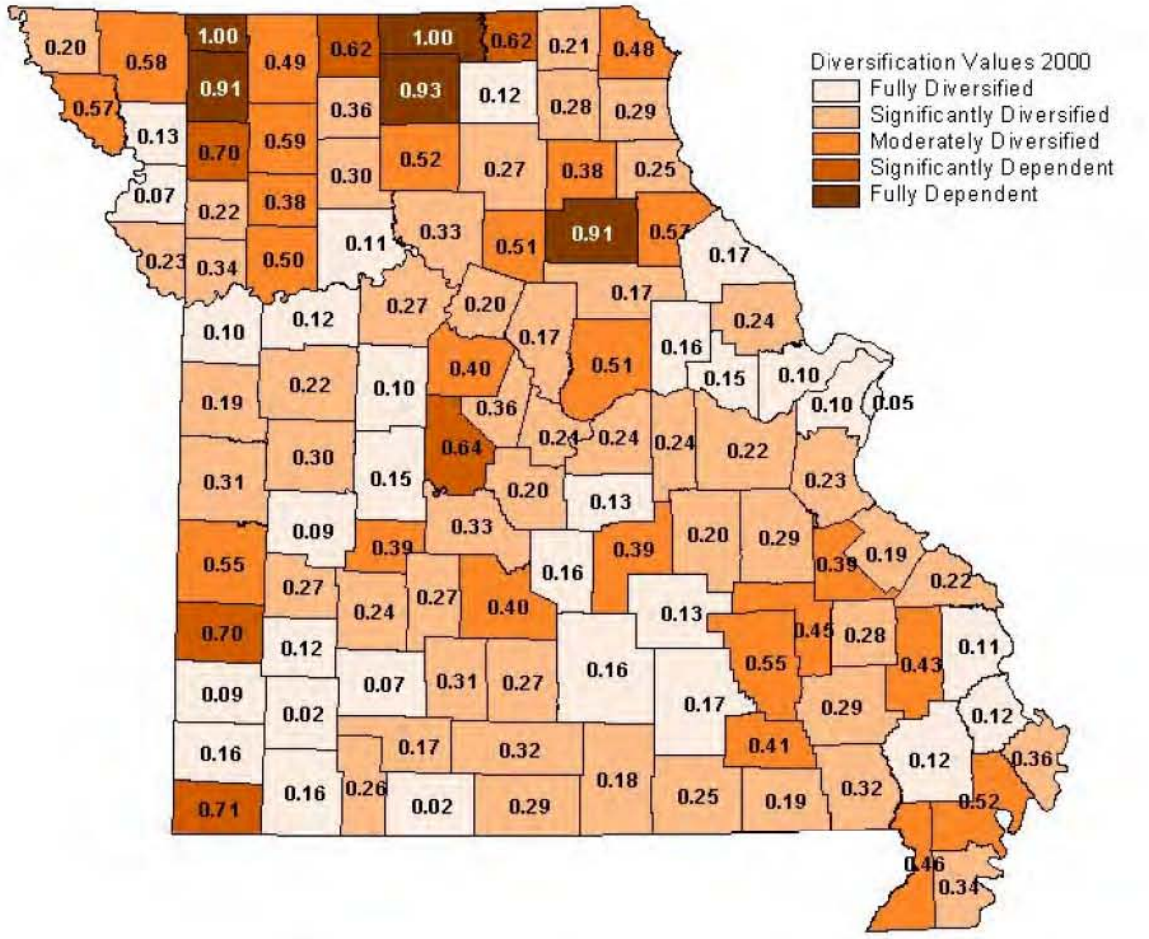

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Table 2.5
Missouri Counties with Fully Diversified Manufacturing Sectors, 2000.
Manufacturing Aggregate Sector Diversification Indices and Employment

COUNTY	AGGREGATE SECTOR EMPLOYMENT				DIVERSIFICATION INDEX
	Top Cycle Manufacturing	Bottom Cycle Manufacturing	Resource Manufacturing	High Tech Manufacturing	
Lawrence	392	524	399	277	0.02
Taney	147	273	166	224	0.02
St. Louis City	10,326	8,543	12,614	3,337	0.05
MISSOURI	**157,763**	**118,381**	**79,464**	**39,589**	**0.07**
Buchanan	2,810	2,073	2,687	537	0.07
Greene	7,468	3,476	6,144	1,761	0.07
Jasper	4,261	3,687	4,623	415	0.09
St. Clair	20	24	2	17	0.09
Jackson	18,403	14,372	6,342	4,034	0.10
St. Louis County	39,314	14,903	8,221	23,022	0.10
Pettis	2,246	1,877	1,928	109	0.10
St. Charles	6,723	3,594	1,132	3,130	0.10
Cape Girardeau	1,122	2,414	2,410	335	0.11
Carroll	161	152	166	0	0.11
Scott	658	841	747	0	0.12
Lafayette	331	379	485	4	0.12
Adair	521	608	415	0	0.12
Stoddard	820	585	1,352	128	0.12
Dade	76	77	51	0	0.12
Dent	47	251	329	96	0.13
Maries	76	42	14	122	0.13
Andrew	14	26	21	0	0.13
Warren	538	958	354	73	0.15
Benton	64	101	48	0	0.15
Texas	136	396	558	67	0.16
Montgomery	138	289	319	0	0.16
Newton	1,402	2,511	707	277	0.16
Pulaski	132	93	47	5	0.16
Barry	1,211	3,214	2,376	35	0.16
Pike	157	428	41	173	0.17
Shannon	17	305	353	104	0.17

Source: MERIC, MO Department of Economic Development

Table 2.6
Missouri Counties with Fully Dependent Manufacturing Sectors, 2000.
Manufacturing Aggregate Sector Diversification Indices and Employment

COUNTY	AGGREGATE SECTOR EMPLOYMENT				DIVERSIFICATION INDEX
	Top Cycle Manufacturing	Bottom Cycle Manufacturing	Resource Manufacturing	High Tech Manufacturing	
Worth	0	17	0	0	1.00
Putnam	72	0	0	0	1.00
Sullivan	17	27	1,517	0	0.93
Gentry	310	6	5	0	0.91
Monroe	32	1,058	8	0	0.91

Change Analysis

The levels of diversification in the counties have fluctuated over the decade as a result of introduction of new industries or closure/relocation of existing industries in addition to changes in levels of industry employment. These changes were considered for the period between 1990 and 1995, and between 1995 and 2000, to identify positive as well as negative variances over the decade. A negative percentage change indicates an increase in the diversification, while a positive change shows a decrease in diversification within the county.

The results indicate that between 1990 and 1995, the most significant changes were attributed to increases rather than to reduction in diversification. Atchison, Chariton and Stone counties significantly increased diversification of their manufacturing bases from fully or significantly dependent to significantly diversified. Gentry, Carroll and Putnam however noted a reduction in the mix of their manufacturing sectors, albeit to a relatively smaller degree. Refer to Table 2.7

Table 2.7
Manufacturing Diversification Changes, 1990-1995
Most positively and adversely affected counties in Missouri

COUNTY	Diversification Index 1990	Diversification Index 1995	Diversification Change	1990 Level of Diversification	1995 Level of Diversification
Atchison	0.88	0.28	-0.59	Fully Dependent	Significantly Diversified
Chariton	0.83	0.30	-0.53	Fully Dependent	Significantly Diversified
Stone	0.67	0.17	-0.50	Significantly dependent	Significantly diversified
Webster	0.59	0.32	-0.27	Significantly dependent	Significantly diversified
Pike	0.33	0.07	-0.26	Significantly diversified	Fully diversified
Holt	0.79	0.54	-0.25	Significantly dependent	Moderately diversified
Audrain	0.56	0.39	-0.17	Moderately diversified	Moderately diversified
Adair	0.30	0.14	-0.16	Significantly diversified	Fully diversified
Texas	0.52	0.37	-0.15	Moderately diversified	Moderately diversified
Gasconade	0.39	0.24	-0.15	Moderately diversified	Significantly diversified
Pemiscot	0.32	0.39	0.08	Significantly diversified	Moderately diversified
Schuyler	0.34	0.43	0.09	Significantly diversified	Moderately diversified
Macon	0.26	0.36	0.10	Significantly diversified	Significantly diversified
Polk	0.23	0.36	0.13	Significantly diversified	Significantly diversified
Cooper	0.24	0.39	0.15	Significantly diversified	Moderately diversified
DeKalb	0.23	0.40	0.17	Significantly diversified	Moderately diversified
Bollinger	0.36	0.53	0.17	Significantly diversified	Moderately diversified
Putnam	0.76	1.00	0.24	Significantly dependent	Fully dependent
Carroll	0.16	0.42	0.25	Significantly diversified	Moderately diversified
Gentry	0.37	0.83	0.46	Moderately diversified	Fully dependent

Source: MERIC, MO Department of Economic Development

Between 1995 and 2000, Caldwell altered its manufacturing base from fully dependent to moderately diversified. Pulaski and Carroll counties showed substantial increases in their manufacturing bases from moderate to full diversification. Ray, Phelps and DeKalb counties had marked reductions in diversification. Refer to Table 2.8

Table 2.8
Manufacturing Diversification Changes, 1995-2000
Most positively and adversely affected counties in Missouri

COUNTY	Diversification Index 1990	Diversification Index 1995	Diversification Change	1990 Level of Diversification	1995 Level of Diversification
Caldwell	0.87	0.38	-0.48	Fully Dependent	Moderately Diversified
Pulaski	0.55	0.16	-0.39	Moderately Diversified	Fully Diversified
Carroll	0.42	0.11	-0.30	Moderately Diversified	Fully Diversified
Hickory	0.64	0.39	-0.25	Significantly Dependent	Moderately Diversified
Audrain	0.39	0.17	-0.22	Moderately Diversified	Significantly Diversified
Texas	0.37	0.16	-0.21	Moderately Diversified	Fully Diversified
Dade	0.34	0.12	-0.21	Significantly Diversified	Fully Diversified
Lawrence	0.20	0.02	-0.19	Significantly Diversified	Fully Diversified
Cole	0.38	0.21	-0.17	Moderately Diversified	Significantly Diversified
Harrison	0.66	0.49	-0.17	Significantly Dependent	Moderately Diversified
Butler	0.21	0.32	0.11	Significantly Diversified	Significantly Diversified
Mercer	0.45	0.62	0.18	Moderately Diversified	Significantly Dependent
Schuyler	0.43	0.62	0.19	Moderately Diversified	Significantly Dependent
Washington	0.10	0.29	0.19	Fully Diversified	Significantly Diversified
Clark	0.27	0.48	0.20	Significantly Diversified	Moderately Diversified
Carter	0.20	0.41	0.20	Significantly Diversified	Moderately Diversified
Raynolds	0.24	0.55	0.30	Significantly Diversified	Moderately Diversified
DeKalb	0.40	0.70	0.31	Moderately Diversified	Significantly Dependent
Phelps	0.06	0.39	0.33	Fully Diversified	Moderately Diversified
Ray	0.15	0.50	0.34	Fully Diversified	Moderately Diversified

Source: MERIC, MO Department of Economic Development

III. Manufacturing Specialization Ratios

Specialization ratios (SRs), also known as location quotients, are measures of county employment concentration in a given economic sector relative to the state average. SRs indicate areas of potential economic growth within the county, or a county's comparative advantage in a given sector. Comparing these ratios over time gives an indication of the relative strengths and weaknesses of the manufacturing sector. SRs greater than 1.0 indicate that the county is relatively more specialized in that industry relative to the state as a whole; or that the county has a comparative advantage in that industry. SRs less than 1.0 indicate that the county is relatively less specialized in that industry relative to the state as a whole, which may indicate a potential area for growth; or that the county does not have a comparative advantage in that industry.

$$SR_{sec\,tor} = \left(\frac{\left(\frac{SECTOR\_EMPLOYMENT_{county}}{TOTAL\_EMPLOYMENT_{county}} \right)}{\left(\frac{SECTOR\_EMPLOYMENT_{state}}{TOTAL\_EMPLOYMENT_{state}} \right)} \right)$$

Generally speaking, SRs compare the percent employed in a given industry within a county relative to the state as a whole. It is important to note that SRs measure the proportion of sector employment relative to the state average, and not the total number of jobs. Therefore, although St. Louis may have the largest number of high-technology employees, it accounts for only a small percentage of total employment — leading to a small SR. The following compares SRs for the aggregate manufacturing sectors defined above: top-of-cycle, bottom-of-cycle, resource-based and high technology.

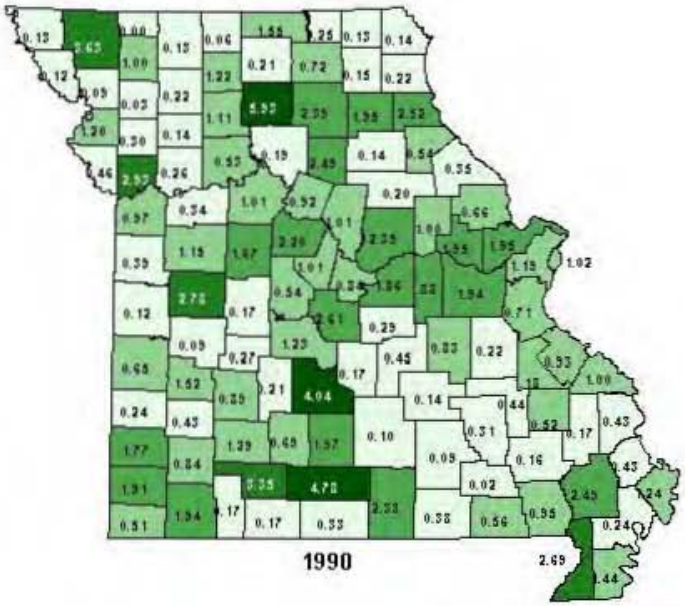
Top-of-Cycle Manufacturing

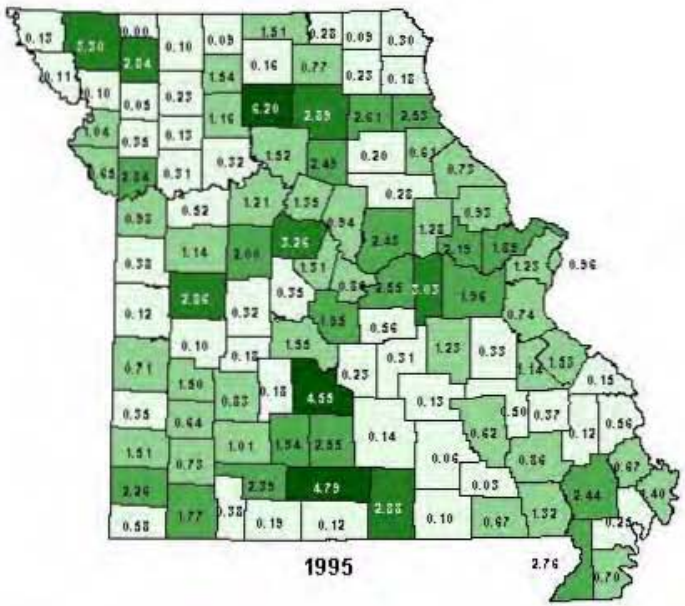
Top-of-cycle manufacturing industries are those that typically require highly skilled technical labor. Between 1990 and 2000, the number of counties that have above average specialization in this type of manufacturing has increased - from forty-one in 1990, to forty-six in 1995, and to forty-seven in 2000. In 2000, specialization in top-cycle manufacturing was spread over most economic regions of the state, with a high concentration in 7 major areas. These were: (1) the US 36 corridor from Hannibal to Brookfield - Linn, Marion, Randolph, and Macon counties; (2) the South Central areas - Laclede, Douglas, Christian, Wright, Webster and Howell counties; (3) the Maryville/Albany area - Nodaway and Gentry counties; (4) the area between Clinton and Booneville - Henry, Pettis and Cooper counties; (5) Gasconade and surrounding counties - Franklin, Crawford, Callaway, Osage and Miller; (6) Dunklin and Pemiscot counties in the Bootheel region; and (7) Clay county in the west.

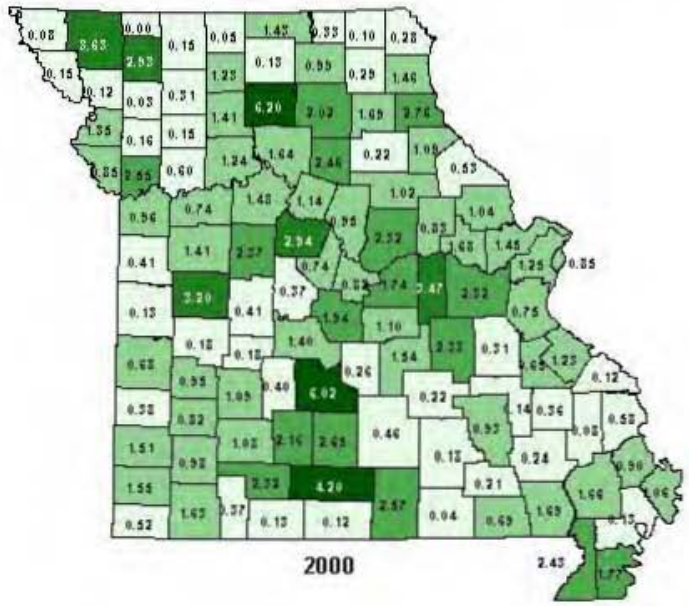
High specialization in top-cycle manufacturing may produce positive externalities in the community. These include a highly skilled workforce, higher wages, and more jobs that are less prone to relocation abroad and automation. The state average annual wages in top-cycle manufacturing were $27,481 in 1990, $33,356 in 1995 and $43,164 in 2000. Further, possessing a highly skilled workforce can be an asset in attracting other firms to the county.

In general, the southeastern, west central areas, excluding the metro areas and northern portions of Missouri excluding the US 36 corridor from Hannibal to Brookfield have low employment in top-cycle manufacturing, relative to the state average. However, in absolute numbers top-of-cycle manufacturing employment is concentrated in the metropolitan areas of the state: St. Louis, Jackson, and Clay counties, St. Louis City, Greene, St. Charles and Jasper counties. Employment is also moderately concentrated in Laclede, Pettis, Cole, Linn, Howell and Butler counties.
It is important to note that SRs measure the proportion of sector employment relative to the state average, not the total number of jobs. Therefore, although certain metro areas may have the large numbers of top-cycle employees (i.e. Kansas City and Springfield), it accounts for only a small percentage of total employment — leading to a small SR.

Top of Cycle Manufacturing Specialization Ratios

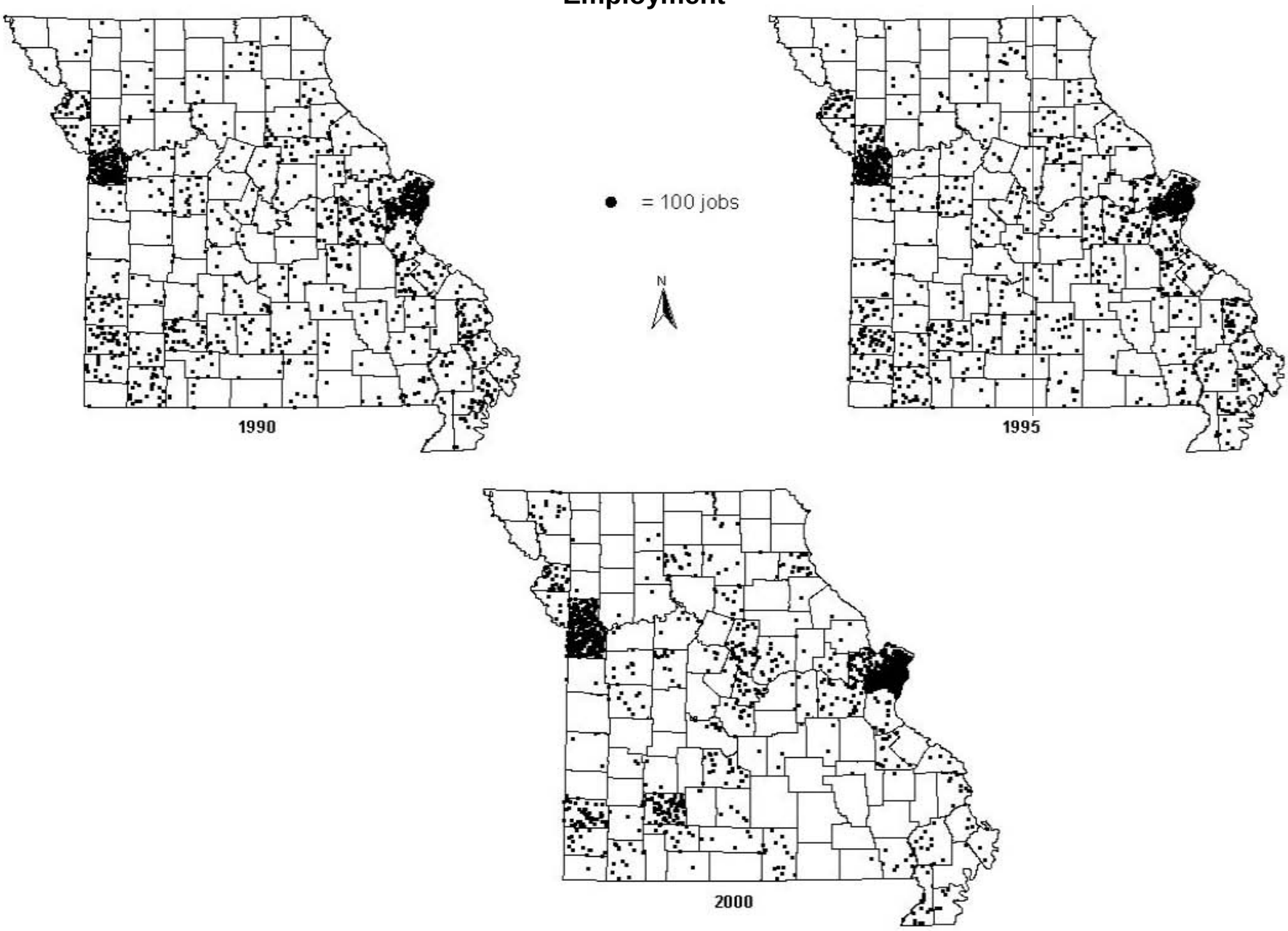






Specialization Ratios
- Low Specialization
- Average Specialization
- Above Average Specialization
- High Specialization
- Very High Specialization

Top of Cycle Manufacturing Employment



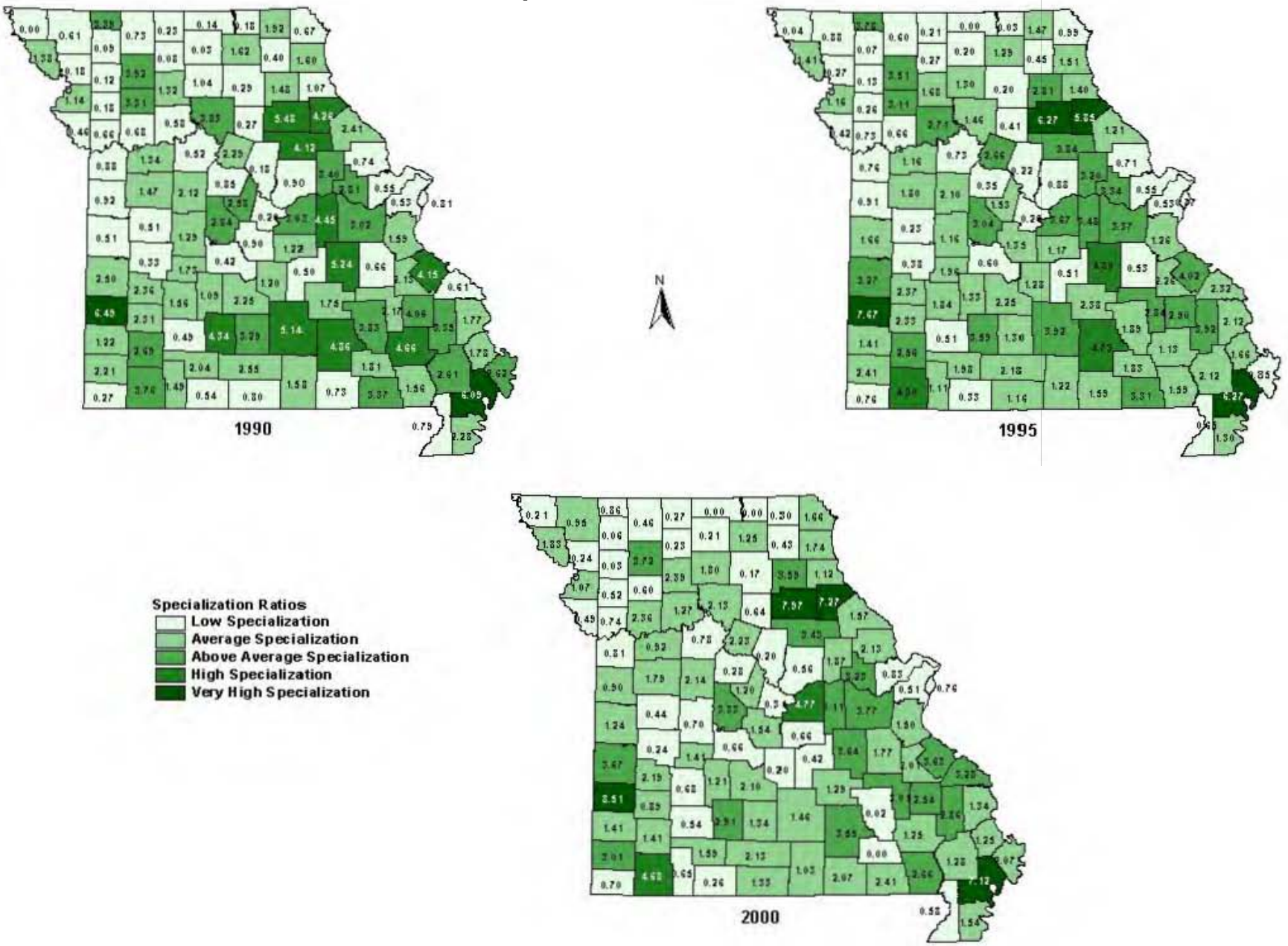
Bottom-of-Cycle Manufacturing

Bottom-of-cycle manufacturing industries are those that require assembly and materials handling labor for standardized production. Between 1990 and 2000, the number of counties that had above average specialization in this type of manufacturing decreased from seventy in 1990 to sixty-eight in 2000. In 2000, bottom-cycle manufacturing was concentrated in the east central (Monroe, Ralls, Osage and Franklin counties), southeast (New Madrid, St. Genevieve and Perry counties), and southwest regions (Barton, Barry and Vernon counties) of the state. Reflecting national trends, declines in this type of manufacturing are due mainly to automation and the movement of operations to lower wage areas abroad. As a result, local economies highly concentrated in bottom-cycle manufacturing may be vulnerable to job losses due to firm relocations.

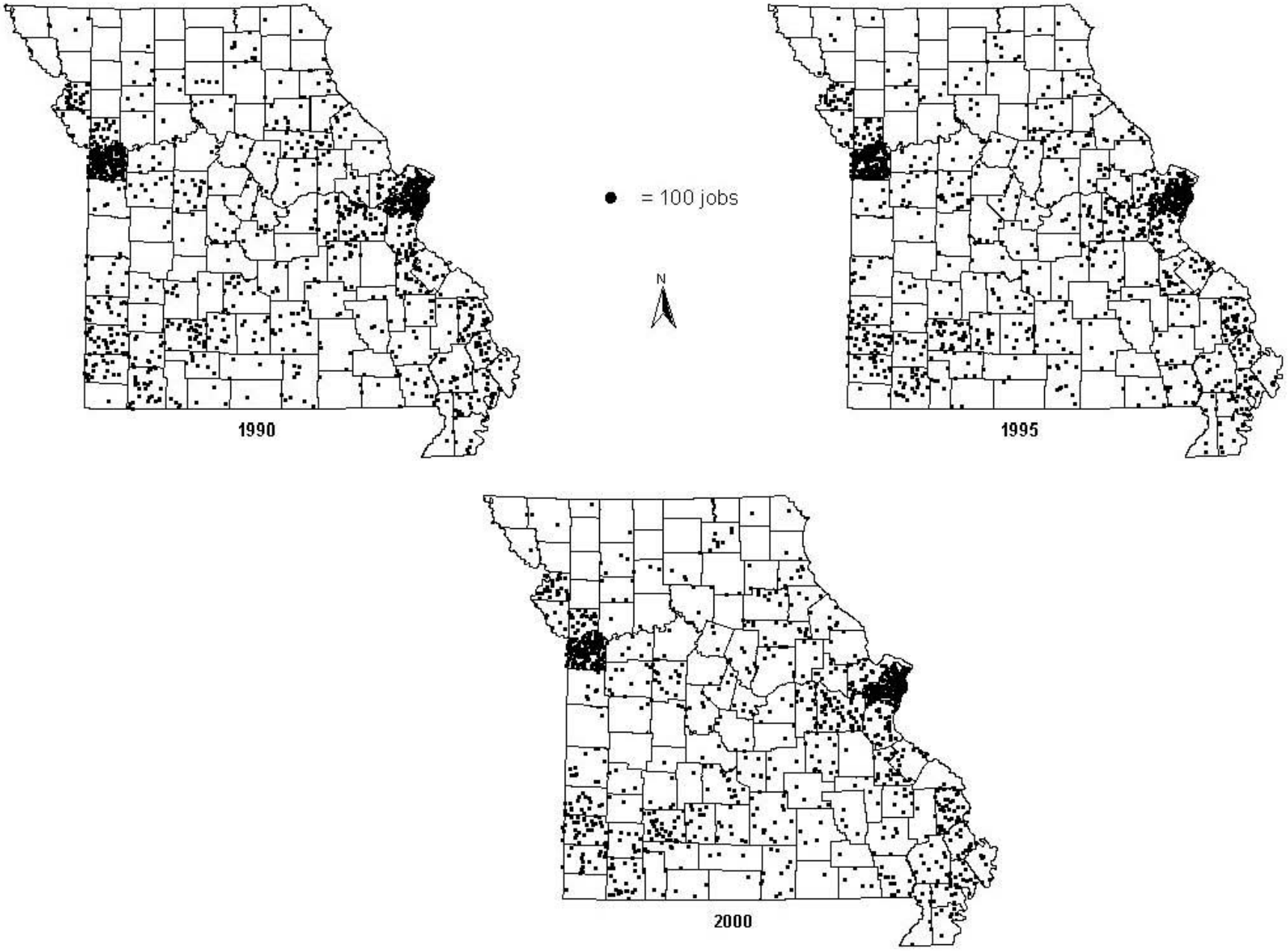
High specialization in bottom-cycle manufacturing to a large extent may produce negative externalities in the community. These include a poorly skilled workforce, lower wages, and potential job losses due to relocation abroad and automation. Having a poorly skilled workforce may be a hindrance in attracting high wage employment to the county. The state average annual wages in bottom-cycle manufacturing were $22,001 in 1990, $26,082 in 1995 and $32,513 in 2000.

In general, specialization in bottom-cycle manufacturing is low in the major metropolitan areas, relative to the state average. However, in absolute numbers bottom-of-cycle manufacturing employment is concentrated in the metropolitan areas of the state. The reason for this is that SRs measure the proportion of sector employment relative to the state average, not the total number of jobs. Therefore, although metro areas may have the largest number of bottom-cycle employees, they account for only a small percentage of total employment - leading to a small SR. Employment is moderately concentrated in Barry, Barton and Vernon in the southwest, Johnson and Pettis counties, Buchanan and Platte counties, and Butler, St Francois, St. Genevieve and Perry to the southeast of the state.

Bottom of Cycle Manufacturing Specialization Ratios



Bottom of Cycle Manufacturing Employment



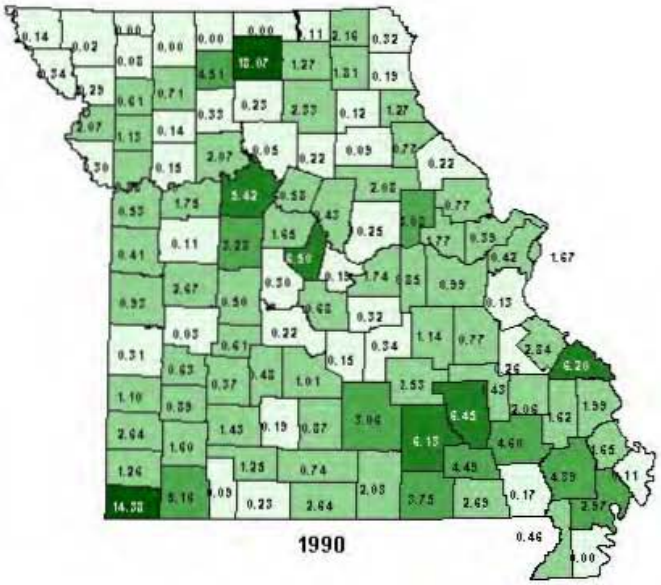
Resource-Based Manufacturing

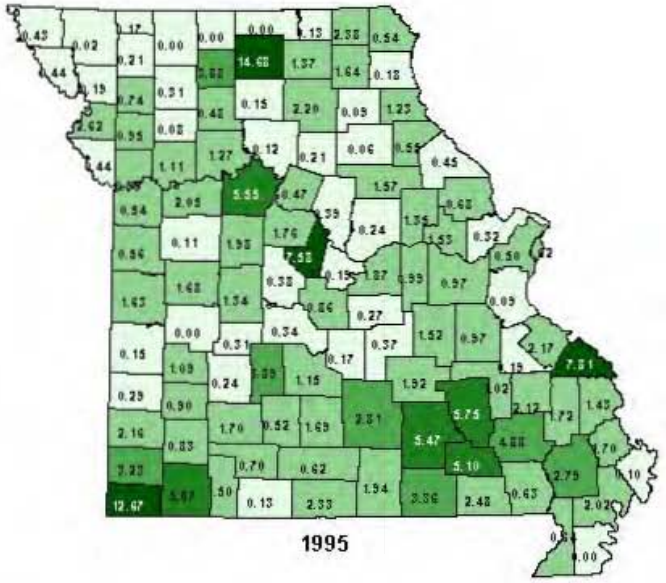
Resource-based manufacturing industries are those that typically require access to natural resources or agricultural products. Between 1990 and 2000, the number of counties that are highly specialized in this type of manufacturing declined from fifty-seven in 1990, to fifty-three in 1995 and fifty in 2000. In the three years, this type of manufacturing has been concentrated in three main areas of the state. First, the south-central and southeast area -Reynolds, Shannon and Perry counties, involved mainly in the production of lumber and wood products. McDonald and Barry counties in the southwest corner of the state are involved in food processing. Finally, Sullivan, Grundy, Moniteau and Saline counties in the central and north central regions of the state are primarily involved in agricultural and food processing. Additionally, Buchanan County in the western edge of the state is primarily involved in tobacco production.

In general, manufacturing of this type is relatively dependent on access to natural and agricultural resources. Areas without these resources would be hard pressed to develop the resource-based manufacturing sector. Average annual state wages in resource based manufacturing were $25,220 in 1990, $31,408 in 1995 and $36,033 in 2000.

In terms of absolute numbers, resource-based manufacturing employment is concentrated in the metropolitan areas of the state. The reason for this is that SRs measure the proportion of sector employment relative to the state average, not the total number of jobs. Therefore, although metro areas have the largest number of resource-based employees, they account for only a small percentage of total employment — leading to a small SR. Employment is also moderately concentrated in McDonald and Barry counties in the southwest, Pettis, and Saline counties, Perry and Stoddard in the southeast and Sullivan county in the north of the state.

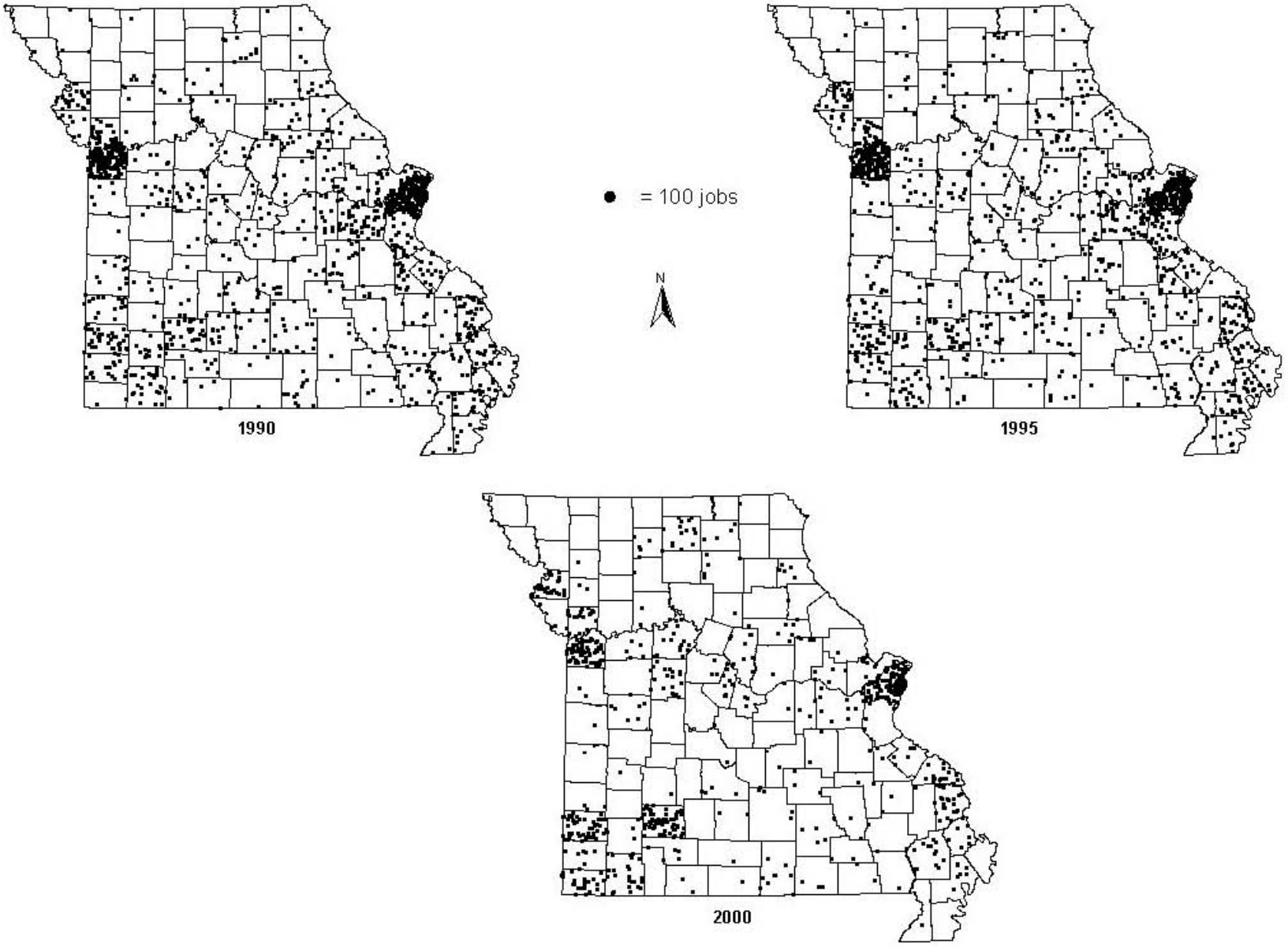
Resource Based Manufacturing
Specialization Ratios





Specialization Ratios
- Low Specialization
- Average Specialization
- Above Average Specialization
- High Specialization
- Very High Specialization

Resource Based Manufacturing Employment



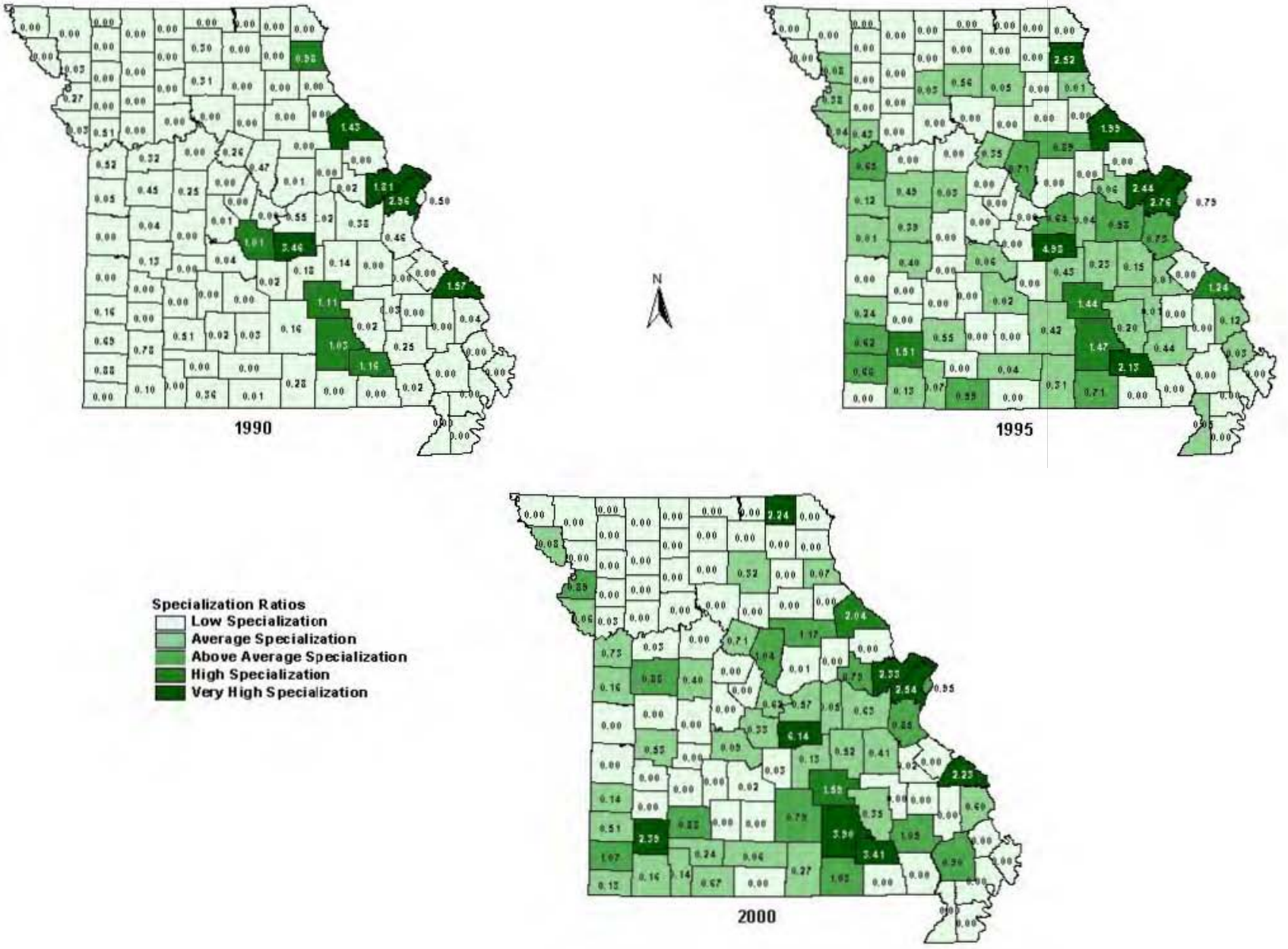
High-Technology Manufacturing

High technology manufacturing industries are those that require an above average number of engineers, engineering technicians, mathematicians, computer scientists, and life scientists (including chemists and geologists). Between 1990 and 2000, the number of counties that are highly specialized in this type of manufacturing has increased - from five in 1990 to eleven in 2000. In 2000, high-tech manufacturing was concentrated in seven areas of the state: (1) the Lake of the Ozarks region (Manes county); (2) Shannon and Carter counties in the south central region; (3) suburban St. Louis (St. Louis and St. Charles counties); (4) Lawrence county in the southwest of Missouri; (5) Scotland county in the northeast (6) Perry county; and (7) Pike county. In general, the northern, west central, south central and southeastern portions of Missouri have low concentrations of high-tech specialization, relative to the state as a whole.

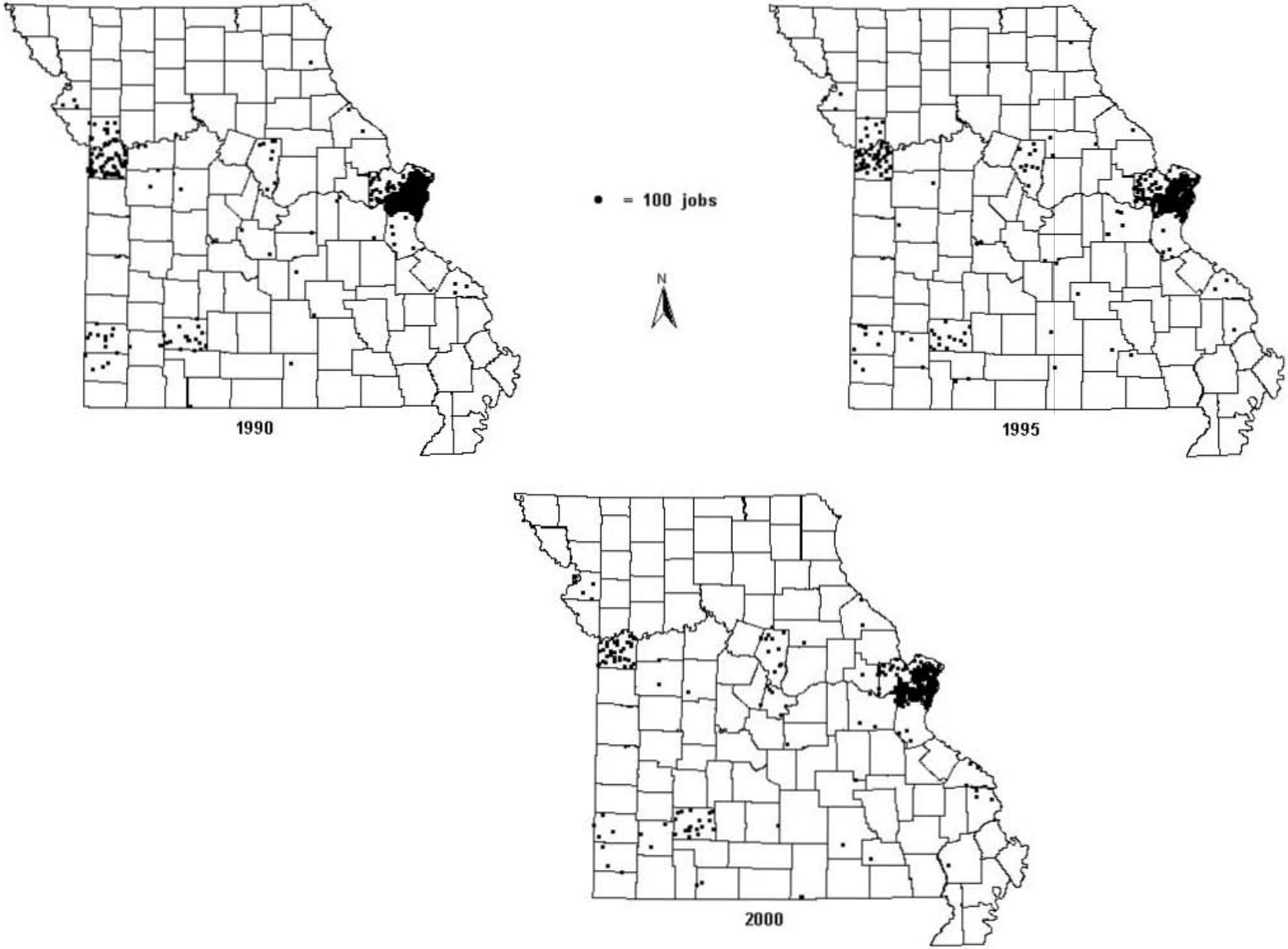
High specialization in high-technology manufacturing often produces positive externalities in the community. These include a highly skilled workforce, higher wages, and jobs that are less prone to relocation abroad and automation. Further, possessing a highly skilled workforce can be an asset in attracting other firms to the county. The average annual wages in high technology manufacturing were $38,780 in 1990, $50,700 in 1995 and $55,115 in 2000.

In terms of absolute numbers, high-technology manufacturing employment is concentrated in the metropolitan areas of the state — contrary to their SRs. The reason for this is that SRs measure the proportion of sector employment relative to the state average, not the total number of jobs. Therefore, although metro areas may have the largest number of high-technology employees, it accounts for only a small percentage of total employment — leading to a small SR. Employment is also moderately concentrated in the Fulton /Jefferson City area, Cole County, Lawrence, Perry, Taney and Johnson counties.

High Technology Manufacturing
Specialization Ratios



High Technology Manufacturing Employment



IV. Implications and Summary

The manufacturing sector still constitutes an important part of local and regional economies in the United States, especially in rural areas. Given the nature of the global economy, policy-makers need to identify areas of economic comparative advantage that they can build upon; and areas of economic vulnerability that they need to strengthen. It is important to understand that manufacturing is a diverse industry in terms of both the products it produces and the labor skills it requires. It cannot be conceptualized as a homogenous sector.

Missouri has a significantly diversified manufacturing base and has increasingly become so over the past decade. This indicates that Missouri's manufacturing economy is relatively robust, and would generally be able to withstand macroeconomic fluctuations. In 2000, counties that had a fully diversified manufacturing base include Lawrence, Taney, St. Louis City, Buchanan, Greene, Jasper, St. Clair, Jackson, St. Louis County, and Pettis. However, several counties are fully dependent on one type of manufacturing. These areas are located in the northern portion of Missouri and include Worth, Putnam, Sullivan, Gentry and Monroe Counties.

Between 1990 and 2000, the number of counties that are highly specialized in top-of-cycle manufacturing has increased - from forty-one in 1990 to forty-seven in 2000. In 2000, top-cycle manufacturing employment was concentrated in seven areas of the state. In general, the southeastern, western areas excluding the metro areas and northern portions of Missouri excluding the US 36 corridor from Hannibal to Brookfield have low employment in top-cycle manufacturing, relative to the state average. High specialization in top-cycle manufacturing generally produces positive externalities in the community. These include a highly skilled workforce, higher wages, and more jobs that are less prone to relocation abroad and automation.

Between 1990 and 2000, the number of counties that are highly specialized in bottom-of-cycle manufacturing has decreased - from seventy in 1990 to sixty-eight in 2000. In 2000, bottom-cycle manufacturing was concentrated in the east central, southeast and southwest regions of the state. Reflecting national trends, declines in this type of manufacturing are due mainly to automation and the movement of operations to lower wage areas abroad. As a result, local economies highly concentrated in bottom-cycle manufacturing may be vulnerable to job losses due to firm relocations.

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Between 1990 and 2000, the number of counties that are highly specialized in resource-based manufacturing declined - from fifty-seven in 1990 to fifty in 2000. Over the decade, this type of manufacturing has been concentrated in three main areas of the state. The south-central and southeast areas are involved mainly in the production of lumber and wood products, counties in the southwest corner of the state are involved in food processing, and the central and north central regions of the state are primarily involved in agricultural and food processing. Additionally, Buchanan County in the western edge of the state is primarily involved in tobacco production.

Between 1990 and 2000, the number of counties that are highly specialized in high-technology manufacturing has increased - from five in 1990 to eleven in 2000. In 2000, high-tech manufacturing was concentrated in seven areas of the state. In general, the northern, west central, south central and southeastern portions of Missouri have low concentrations of high-tech specialization, relative to the state as a whole. High specialization in high-technology manufacturing may produce positive externalities in the community, including a highly skilled workforce, higher wages, and jobs that are less prone to relocation abroad and automation.

Ultimately, different types of manufacturing produce different types of positive and negative externalities. For example, manufacturing firms that require a high degree of skilled technical labor may produce a more educated workforce, higher wages, and globally competitive jobs that are secure. In contrast, firms that require little or no skilled labor may produce a poorly educated workforce, lower wages, and jobs that are prone to be moved to low wage nations abroad. Therefore, it is important that policy-makers understand the types of manufacturing that exist in their area in order to assess these potential economic and external effects.

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Appendix - Standard Industry Classifications

SIC CODE	INDUSTRY
TOP OF CYCLE MANUFACTURING	
27	Printing, publishing and allied industries
28 (exclude 281, 283, 286)	Chemicals and allied products
35 (exclude 357)	Machinery, except electrical
36 (exlcude 366, 367)	Electrical machinery
37 (exclude 372, 376)	Transportation equipment
38 (exclude 381, 382)	Instruments and related products
BOTTOM OF CYCLE MANFACTURING	
22	Textile mill products
23	Apparel and other textile products
24	Furniture and fixtures
30	Rubber and miscellaneous plastic products
31	Leather and leather products
32	Stone, clay and glass products
33	Primary metal industries
34	Fabricated metal products
39	Miscellaneous manufacturing industries
RESOURCE BASED MANUFACTURING	
20	Food and kindred products
21	Tobacco products
24	Lumber and wood products
26	Paper and allied products
29	Petroleum and coal products
HIGH TECHNOLOGY MANUFACTURING	
281	Industrial inorganic chemicals
283	Drugs
286	Industrial organic chemicals
357	Computer and office equipment
366	Communications equipment
367	Electronic components and accessories
372	Aircraft and parts
376	Guided missiles, space vehicles, parts
381	Search and navigation equipment
382	Measuring and controlling devices

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